ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 10, April 2013

Detection of Malarial Parasite in Blood Using Image Processing

Pallavi T. Suradkar

Abstract*--This paper reviews image analysis studies aiming at automated diagnosis or screening of malaria infection in microscope images of thin blood film smears. Malaria is a mosquito-borne infectious disease of humans and other animals caused by parasites (a type of microorganism) of the genus Plasmodium. Infection is initiated by a bite from an infected female mosquito, which introduces the parasites via its saliva into the circulatory system, and ultimately to the liver where they mature and reproduce. The disease causes symptoms that typically include fever and headache, which in severe cases can progress to coma or death. Malaria is widespread in tropical and subtropical regions in a broad band around the equator, including much of Sub-Saharan Africa, Asia, and the Americas.

***Keywords*—grayscale image, Binary image and thresholding, Blobs detection, Parasite color intensity selection, RBCs and parasite count.**

I. INTRODUCTION

Malaria is a life-threatening parasitic disease, caused by the protozoan parasites of the genus Plasmodium and is transmitted through the bite of a female Anopheles mosquito. Inside the human body, the parasite undergoes a complex life cycle in which it grows and reproduces. During this process, the red blood cells (RBCs) are used as hosts and are destroyed afterwards. Hence, the ratio of parasite-infected cells to the total number of red blood cells – called important determinant in selecting the appropriate treatment and drug dose .

II. FACTS AND FIGURES

Approximately, 40% of the world's population, mostly those living in the world's poorest countries, is at risk of malaria. A child dies of malaria every 30 seconds. Every year, more than 500 million people become severely ill. With malaria. Between 300 million and 500 million people in Africa, India, Southeast Asia, the Middle East, the South Pacific, and Central and South America have the disease. The worldwide annual economic burden of malaria, calculated to include spending on prevention and treatment as well as loss of productivity due to illness, was estimated at US$ 500 million in 2005.

III. DIAGNOSIS OF MALARIA

The definitive diagnosis of malaria infection is done by searching for parasites in blood slides (films) through a microscope. In peripheral blood sample visual detection and recognition of Plasmodium is possible and efficient via a chemical process called (Giemsa) staining. The staining process slightly colorizes the red blood cells (RBCs) but highlights Plasmodium parasites, white blood cells (WBC), and platelets or artefacts. The detection of Plasmodium spp requires detection of the stained objects. However, to prevent false diagnosis the stained objects have to be analyzed further to determine if they are parasites or not. In the fig.1:,There are four types of human malaria – Plasmodium falciparum, P. vivax, P. malariae, and P. ovale. P. falciparum and P. vivax are the most common. P. falciparum is by far the most deadly type of malaria infection.

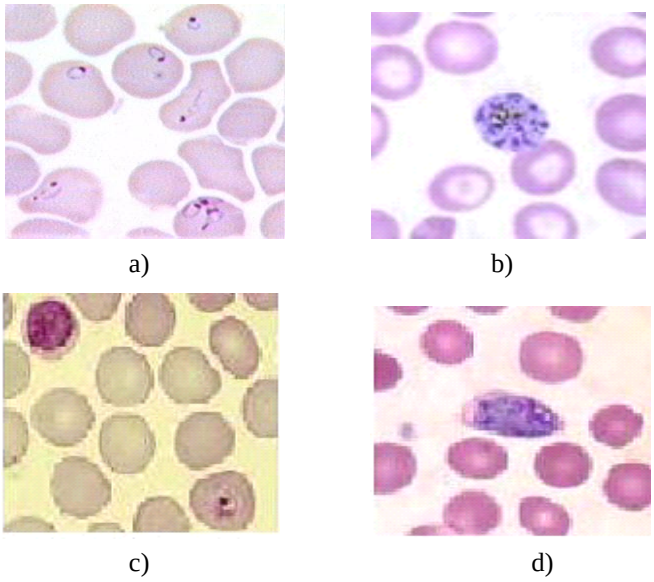


Fig 1. a) Plasmodium Falciparum (b) P. Vivax (c) P. Malariae (d) P. Ovale

IV. GOAL

The biggest detraction of microscopy, namely its dependence on the skill, experience and motivation of a human technician, is to be removed. Used with an automated digital microscope, which would allow entire slides to be examined, it would allow the system to make diagnoses with a high degree of certainty. It would also constitute a diagnostic aid for the increasing number of cases of imported malaria in traditionally malaria-free areas, where practitioners lack experience of the disease.

V. OBJECTIVES

The objective of the project is to develop a fully automated image classification system to positively identify malaria parasites present in thin blood smears, and differentiate the species. The algorithm generated will be helpful in the area where the expert in microscopic analysis may not be available. The effort of the algorithm is to detect presence of

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 10, April 2013

parasite at any stage. One of the parasites grows in body for 7 to 8 days without any Symptoms. So if this algorithm is incorporated in routine tests, the presence of malarial parasite can be detected Automatic parasite detection has based on color histograms. In a diagnosis scenario In this study we have proposed a solution for the parasite detection problem with two consecutive classifications.

VI. TEST ALGORITHM AND SYSTEM ARCHITECTURE

The design is essentially an image classification problem, and thus takes the form of a standard pattern recognition and classification system. It consists of five stages:

1. Image Acquisition (Done using high resolution Digital Camera)
2. RBC Extraction
3. Edge Detection
4. Binary Image
5. RBC Counting
6. Thresholding
7. Parasite Extraction

System architecture used for Malaria parasite detection involves following steps:

Thresholding, gray scale image conversion, binary image, edge detection algorithm, thinning of binary image, labeling algorithm. Block diagram of system architecture is shown in Figure 2

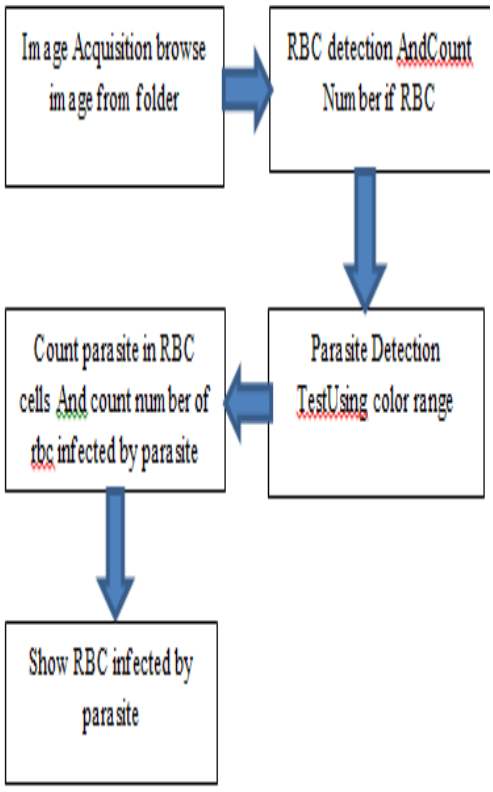


Fig 2: System Block Architecture

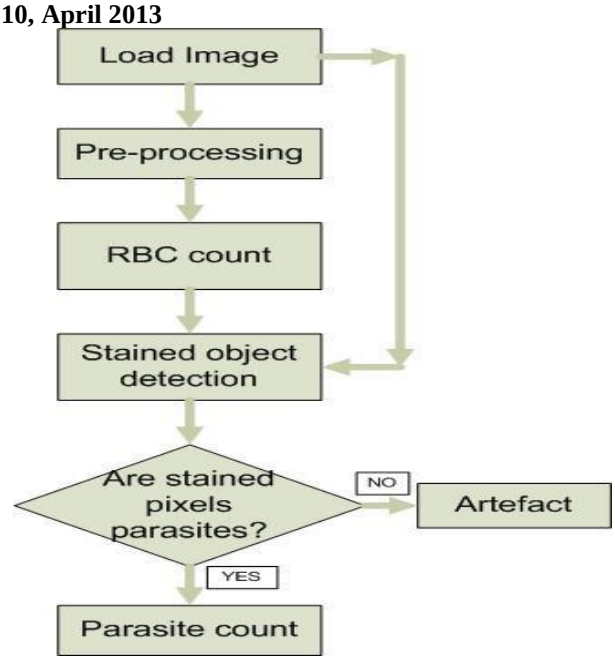


FIG 3: Flowchart

VII. PRE-PROCESSING

The purpose of pre-processing is to remove unwanted objects and noise from the image to facilitate image segmentation into meaningful regions. The steps required to carry out image pre-processing were implemented on low resolution images are as follows:

i) Load coloured (RGB) or gray scale image, the coloured image is converted to gray scale image. The contrast of the gray scale image is enhanced using local histogram equalization to enhance the visibility of the parasites and RBC.

ii) The next and important step in image segmentation is to extract meaningful regions, or in other words, distinguish objects from background. The common way described in the literature is to use edge detection algorithms. Edge detection or boundary detection algorithm use to segment image into meaningful regions, i.e. RBC and artefacts from the background is shown in Figure 3

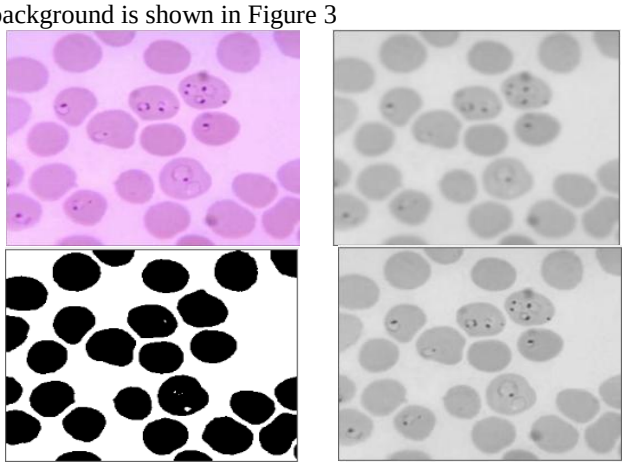


Fig 3: Boundary Extracted Image

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 2, Issue 10, April 2013

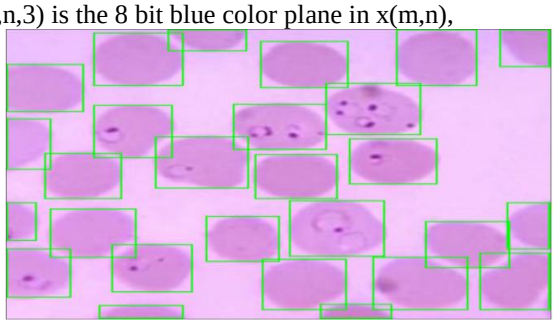
The binary image of statistically similar region generated after segmentation distinguishing RBC and background, but because of biconcave shape of the RBC, the central pallor is assigned the same features as the background as shown in

VIII. RBC COUNTING

Red Blood Cell (RBC) extraction is a very important and vital step in RBC counting. As there is a possibility of other elements to be present on the smear, only RBCs need to be extracted. RBCs are extracted based on their specific color. RBCs are normally red in color and circular in shape. The cells other than RBCs are removed from the image. The obtained image will be consisting of only extracted RBCs. Extraction of RBCs is expressed mathematically in equation below:

$$g(m,n) \models \begin{cases} x(m,n,i) & \text{if}, \quad 170 \le x(m,n,1) \le 255 \quad \& \\ & \quad 150 \le x(m,n,2) \le 201 \quad \& \\ & \quad 160 \le x(m,n,3) \le 220 \\ 255 & \text{Otherwise} \end{cases}$$

Where,
g(m,n) is m rows by n columns 24 bit color image obtained after RBC extraction,
x(m,n,l) is the 8 bit red color plane in x(m,n),
x(m,n,2) is the 8 bit green color plane in x(m,n),
x(m,n,3) is the 8 bit blue color plane in x(m,n),

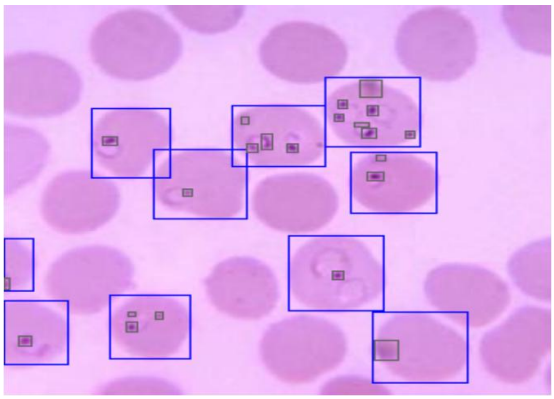


For further processing the image need to be converted to gray color, whereby the image, which was in true color previously having 24-bit depth, will get converted to gray color having 8-bit depth. During conversion to gray color few cells lose their contents and become hallow, these cells need to be filled. Ideally the RBCs, which are pale in color, are abnormal and can be considered as color abnormality. But for the purpose of counting number of RBCs these hallowed cells need to be filled up. The lost contents of the cell are filled by flood fill technique. The image, which was gray scale image, is now converted to binary level image with the help of Adaptive Thresholding or Dynamic Thresholding.

IX. MALARIA IDENTIFICATION

Now there exists a ring shape malaria parasite on RBCs. These parasites are having shape like a ring and the ring is generally of blue color. Extraction of Color Intensity range for malarial parasite expression mathematically express in equation below

$$g(m,n) \models \begin{cases} x(m,n,i) & \text{if}, \quad 127 \le x(m,n,1) \le 202 \quad \& \\ & \quad 35 \le x(m,n,2) \le 131 \quad \& \\ & \quad 143 \le x(m,n,3) \le 211 \\ 255 & \text{Otherwise} \end{cases}$$



X. CONCLUSION

The detection of Malaria parasites is done by pathologists manually using Microscopes. So, the chances of false detection due to human error are high, which in turn can result into fatal condition. This seminar curbs the human error while detecting the presence of malaria parasites in the blood sample by using image processing and automation. We achieved this goal using Image Segmentation smoothing processing techniques, gradient edge detection technique to detect malaria parasites in images acquired from Giemsa stained peripheral blood samples. The system in a robust manner so that it is unaffected by the exceptional conditions and achieved high percentages of sensitivity, specificity, positive prediction and negative prediction values. And the extraction of red blood cells achieves a reliable performance and the actual classification of infected cells.

REFERENCES

[1] F. B. Tek, A. G. Dempster, and I. Kale, “Computer vision for microscopy diagnosis of malaria,” Malaria Journal 2009.

[2] F. B. Tek, A. G. Dempster, and I. Kale, “Malaria parasite detection in peripheral blood images,” in Proc. British Machine Vision Conference, Edinburgh, September 2006.

[3] Andrew G Dempster, Izzet kale and F.Boray Tek: computer vision for microscopy diagnosis of malaria.

[4] S. S. Savkare, S. P. Narote “Automatic Detection of Malaria Parasites for Estimating Parasitemia” ICASSP 2009.

[5] www.wikipedia.org.